REMARKS/ARGUMENTS

The Examiner renumbered claims 24-47 as claims 25-48, where the renumbering is shown in the above listing of the claims. Applicants have further amended the claims to correct the dependency of the claims due to the renumbering as requested by the Examiner.

The Examiner found that claims 4, 5, 8-14, 19, 20, 23-29, 34, 35, 38-41, and 44-48 would be allowed if written in independent form including the requirements of the base and intervening claims.

Applicants amended claims 10, 25, 40, and 47 to be in independent form, including the requirements of the base claims to place these claims in condition for allowance. Further, claims 11-14, 26-29, and 41 are patentable over the cited art because they depend from the allowable claims 10, 25, and 40, which are now in independent form.

Claims 4, 5, 8, 9, 20, 23, 24, 34, 35, 38, 39, 44-46, and 48 are patentable over the cited art in their current dependent form because they depend from one of independent claims 1, 16, 31, and 43, which are patentable over the cited art for the reasons discussed below.

Applicants have further added claims 49, 50, and 51, which incorporate the requirements of the allowable claim 47 into the independent method, system, and integrated circuit claims 1, 16, and 31. These claims are patentable over the cited art for the reasons the Examiner found claim 47 to be patentable over the cited art.

Applicants further amended claim 16 to add the cache to the system as a separate limitation and amended claims 31 and 43 to make the cache part of the preamble of the claims.

1.   Claims 1, 2, 15-17, 30-32, and 42-43 are Patentable Over the Cited Art

The Examiner rejected claims 1, 2, 15-17, 30-32, and 42-43 as anticipated (35 U.S.C. §102) by Cheong (U.S. Patent No. 5,533,189).

Independent claims 1, 16, and 31 concern updating data in a storage device, and require: receiving an update to one or more blocks of customer data at addresses in the storage device; for each block of data to update, generating metadata indicating the address of the block in the storage device and an error checking code that is capable of being used to determine whether the customer data in the block has changed; for each block of data to update, writing the block of

data to update and the metadata for the block to cache; and for each block of data to update, transferring the block of data and the metadata for the block from the cache to the storage device.

The Examiner cited col. 1, lines 15-20 and col. 5, lines 60-65 of Cheong as disclosing the claim requirement that for each block of data to update, generating metadata indicating the address of the block in the storage device and an error checking code that is capable of being used to determine whether the customer data in the block has changed. (Office Action, pg. 3) Applicants traverse.

The cited col. 1 mentions that each cache directory entry contains an address tag and status bits, where the address tag is the tag portion of the address. The data entry and directory entry are retrieved by using the index portion of the request address. Although the cited col. 1 discusses a tag address, the tag address concerns the address of the data entry in memory, not the address of a block of data in a storage device to update as claimed. Further, nowhere does the cited col. 1 anywhere disclose that the metadata includes an error checking code that is capable of being used to determine whether the customer data in the block has changed.

Col. 5 of Cheong discusses operations performed by a memory controller for a cache. The address tag is generated for entries in memory. (Col. 5, lines 25-35) The cited col. 5 discusses how the tag is used to access data in memory, and to generate a tag portion of an error correction code. Nowhere does the cited col. 5 anywhere disclose generating metadata indicating a block in the storage device and an error checking code to use to determine whether the customer data has change.

Applicants submit that the cited address tag of Cheong is not the claimed indicated block in the storage device to update. Instead, the cited address tag comprises the tag portion of the address of a data entry in cache in the lowest level of the memory. (Cheong, col. 1, lines 15-20) In the claims, the address of the block in the storage device is different than a cache address because the storage device is the device that is updated, which is separate from the claimed cache.

Moreover, the cited Cheong does not disclose the claim requirement that the metadata include an error checking code that is cable of determining whether the customer data in the block has changed. The cited col. 5 of Cheong discusses an error checking code (ECC) for the tag portion. For instance, Cheong mentions that "ECC generation pertaining to the tag and status

bits can be separated and then the resulting ECC generated for each can then be summed to produce resultant ECC for the directory entry." (Col. 3, lines 44-60). Thus, the cited ECC of Cheong concerns the tag and status bits of the directory entry in cache. The claims on the other hand require that the error checking code be used to determine whether the customer data has changed. Because the ECC of Cheong does not pertain to the actual customer data and instead pertains to the tag and status bits of cache directory entries, the cited ECC of Cheong cannot be used to perform the claim requirement of determining whether the customer data has changed.

The Examiner found that col. 1, lines 30-50 disclose the claim requirements that for each block of data to update, writing the block of data to update and the metadata for the block to cache and for each block of data to update, transferring the block of data and the metadata for the block from the cache to the storage device. (Office Action, pg. 3)

The cited col. 1 discusses status bits for directory entries in cache and how to retrieve entries from cache, and writing status and address tags values to a directory entry in cache. Nowhere does the cited col. 1 anywhere disclose the claim requirements of transferring both a block of data and the metadata for the block, which includes the address of the block in the storage device and the error checking code, to the storage device. Instead, the cited col. 1 concerns writing data to entries in cache, not transferring updated data and its metadata from cache to the storage device as claimed.

Claim 43 includes many of the requirements of claims 1, 16, and 31 in computer readable form, by claiming at least one data structure having: blocks of customer data; and a block of metadata for each block of customer data, wherein the metadata includes the address of the block in the storage device and an error checking code that is capable of being used to determine whether the customer data in the block has changed while the block is in the cache, wherein block of data to update and the metadata for the block are written to cache.

Applicants submit that claim 43 is patentable over the cited Cheong because, for the reasons discussed above, Cheong does not disclose the claim requirements of a block of metadata for each block of customer data, wherein the metadata includes the address of the block in the storage device and an error checking code that is capable of being used to determine whether the customer data in the block has changed while the block is in the cache, wherein block of data to update and the metadata for the block are written to cache.

Accordingly, claims 1, 16, 31, and 43 are patentable over Cheong because the cited art does not disclose all the claim limitations.

Claims 2, 15, 17, 30, 32, and 42 are patentable over the cited Cheong because they depend from one of claims 1, 16, and 31, which are patentable over the cited art for the reasons discussed above. Further, the below discussed dependent claims provide further grounds of distinction over the cited art.

Claims 2, 17, and 32 depend from claims 1, 16, and 31 and further require that for each block of data to update, determining whether the address of the block of data in the metadata and the address in the storage device to update match; and for each block of data to update, performing an operation on the customer data in the block and the error checking code to determine whether the customer data has changed, wherein the block of data to update and metadata for the block is transferred to the storage device if the address of the block in the metadata and requested address match and the customer data has not changed.

The Examiner cited col. 1, line 40 as disclosing the claim requirement that for each block of data to update, determining whether the address of the block of data in the metadata and the address in the storage device to update match. (Office Action, pg. 3) Applicants travers.

The cited col. 1, line 40 mentions that depending on the request type, new status bit values or address tags are written to the directory entry. Nowhere does this cited col. 1 anywhere disclose the claim requirement of determining whether the address of the block of data in the metadata and the address in the storage device to update match. Instead, the cited col. 1 concerns writing status and tags to cache directory entries, which is different from the claim requirement of determining whether the address of data in metadata and the storage device, where the storage device is distinct from the cache, according to the claims.

The Examiner cited col. 1, lines 45-50 as disclosing the claim requirement that for each block of data to update, performing an operation on the customer data in the block and the error checking code to determine whether the customer data has changed, wherein the block of data to update and metadata for the block is transferred to the storage device if the address of the block in the metadata and requested address match and the customer data has not changed. (Office Action, pg. 3). Applicants traverse.

The cited col. 1 mentions that if the request is cast out from cache, the valid bits are set to zero, and when to write a new address tag into the cache directory entry when loading a new data entry from the lower level of memory hierarchy. Nowhere does this cited col. 1 anywhere disclose or suggest performing an operation on the customer data in the block and the error checking code to determine whether the customer data has changed. Instead, the cited col. 1 discusses how to write information, such as tags and bits, to a directory entry in cache. Moreover, nowhere does this cited col. 1 anywhere disclose or suggestion that the block of data to update and metadata for the block is transferred to the storage device if the address of the block in the metadata and requested address match and the customer data has not changed.

Accordingly, claims 2, 17, and 32 provide additional grounds of patentability over the cited art because the additional claim requirements are not disclosed in the cited Cheong.

2.   Claims 3, 6, 7, 18, 21, 22, 23, 36, and 37 are Patentable Over the Cited Art

The Examiner rejected 3, 6, 7, 18, 21, 22, 23, 36, and 37 as obvious (35 U.S.C. §103) over Cheong in view of Wu (U.S. Patent No. 6,021,482). Applicants traverse.

These claims are patentable over the cited art because they depend from one of claims 1, 16, and 31, which are patentable over the cited art for the reasons discussed above. Further, the below discussed dependent claims provide further grounds of distinction over the cited art.

Claims 6, 21, and 36 depend from claims 1, 16, and 31 and further require that generating the error checking code comprises XORing the customer data in the block such that the error checking code comprises a longitudinal redundancy checking code. The Examiner cited col. 7, line 15 of Cheong as teaching the additional requirement of XORing the customer data. (Office Action, pg. 4) Applicants traverse.

The cited col. 7 mentions XORing the ECC associated with said received tag bits and updated status bits. Nowhere does the cited col. 7 anywhere teach or suggest XORing the customer data as claimed. Instead, the cited col. 7 only mentions performing XOR with respect to status and the tag address for the cache directory entries, not the customer data as claimed.

Accordingly, claims 6, 21, and 36 provide additional grounds of patentability over the cited art.

Claims 7, 22, and 37 depend from claims 2, 17, and 32 and further require that generating the metadata and determining whether the address of the block in the storage device and block address in metadata match and performing the operation on the customer data and error checking is performed by a device that is separate from a main processor, wherein the device transfers the block of data from the cache to the storage device using a direct memory access (DMA) channel.

As discussed above, the cited Cheong does not disclose the operations of generating the metadata and determining whether the address of the block in the storage device and block address in metadata match and performing the operation on the customer data and error checking.

The Examiner cited col. 3, line 66 to col. 4, line 5 of Wu as teaching the claim requirement that a device separate from a main processor performs the claimed operations. (Office Action, pg. 4) Applicants traverse.

The cited Wu discusses that control logic performs DMA operation to transfer data between the DRAM and data bus. However, nowhere does the cited Wu nor Cheong disclose any device separate from a main processor that performs the claimed operations of generating the metadata and determining whether the address of the block in the storage device and block address in metadata match and performing the operation on the customer data and error checking.

Accordingly, claims 7, 22, and 37 provide additional grounds of patentability over the cited art.

Conclusion

For all the above reasons, Applicant submits that the pending claims 1-51 are patentable over the art of record. Applicants submit herewith the fee for the added claims. Nonetheless, should any additional fees be required, please charge Deposit Account No. 09-0449.

The attorney of record invites the Examiner to contact him at (310) 553-7977 if the Examiner believes such contact would advance the prosecution of the case.

Dated: <u>January 27, 2004</u>   By:_____
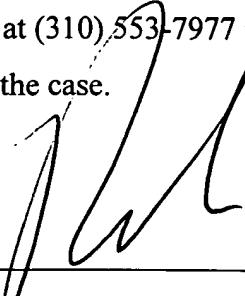
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